in one vascular territory in whom noninvasive testing shows no evidence of contralateral or tandem lesions are candidates for IV digital subtraction angiography. If a patient has several signs or symptoms in several vascular territories or evidence of multiple lesions on noninvasive testing, an intraarterial contrast study is recommended. This should be a standard arteriogram unless selective catheterization is difficult. In the latter case, intraarterial digital subtraction angiography can facilitate the relatively rapid acquisition of information on the extracranial or intracranial extracerebral vessels using modest contrast volumes.

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Magnetic Resonance Imaging Versus Computed Tomography

X-RAY COMPUTED TOMOGRAPHY (CT) has revolutionized diagnosis and management. The information gained from CT scans has contributed to a reduction in the number of electroencephalograms, angiograms, spinal taps, plain skull films and isotope scans formerly done largely as nonspecific screening procedures. With the additional tomographic data available from magnetic resonance (MR) imaging, there will likely be a further reduction in these procedures.

A CT scan shows bone, blood and some grey and white matter distinction, but because the possible interactions of x-rays and tissues are limited, very little soft tissue characterization is possible. Magnetic resonance allows the imaging of hydrogen in tissues by applying a complex sequence of fixed and changing magnetic fields to a region of the body. A patient is placed in a very strong, constant magnetic field, several thousand times the earth's magnetic field. While this field is held constant, a high-frequency alternating current (in the shortwave radio range) is superimposed on this main field for a brief period. This excites hydrogen nuclei in the tissues. About two thirds of a body's atoms are hydrogen. The nucleus of the hydrogen atom behaves like a small bar magnet and tends to orient parallel to the main field. When excited by the radiofrequency pulse, some nuclei are driven out of alignment, returning to their original alignment after about one second. During this return, or decay, time they emit a radio signal at a frequency proportional to the magnetic field they are in. By adding and subtracting from the main field by electromagnetic coils placed around the patient, slight gradual changes (gradients) in field strength between two positions within the patient can be made that cause the resonant frequency of the decaying signal to be position-dependent. By this means, location and imaging of hydrogen in the body are possible.

Magnetic resonance excitation is usually by means of a sequenced pair of pulses separated by a brief interval. The computer expects tissue to be in the same place for both. If blood is moving rapidly, it will not be in the same place and will have been replaced by unexcited hydrogens. The chambers of the heart and the lumina of large vessels therefore appear dark. Blood's movement serves as its own contrast medium. It is reasonable to expect that most angiography (including coronary) eventually will be done by this noninvasive method. Within the limitations of patient movement, spatial resolution is as good as the best CT scan. Other characteristics of hydrogen's resonant frequency and rates of decay of the hydrogen signal provide still more information about tissue characterization.

Cortical bone contains very little hydrogen, so it appears black and is invisible on a scan. Many ordinarily obscured soft tissues such as bone marrow, pituitary, posterior fossa, spinal canal and inner ear structures can be seen with unprecedented clarity. Malignant tumors, edema and inflammation can be differentiated clearly from surrounding healthy tissues because tissue water in these regions is not only greater but appears to be relatively unbound to large molecules and cellular structures.

Magnetic resonance imaging produces so much information without the need to inject contrast material that there is little stimulus to develop new contrast media. And because there is no ionizing radiation, magnetic resonance appears to be completely harmless.

At present the greatest limitations of MR imaging are its long scan time (more than five minutes, making it inappropriate for many patients); its high cost (almost twice as much as a CT scanner); its low patient load (about half of that of CT); its complexity of theory, operation and interpretation (an order of magnitude greater than CT); its large space requirement (several times that of CT), and government resistance to this new technology.

The technology of CT was an order-of-magnitude jump over simple shadow radiography. Magnetic resonance appears to involve a similar jump beyond CT because it offers so much more information about tissues without subjecting patients to ionizing radiation. It should not be considered simply an extension of x-ray CT.

Because it is not radiologic in nature and is so complex, MR imaging will offer so much information to so many specialties that the performance and interpretation of this remarkably diverse new clinical probe of tissues inevitably will become interdisciplinary and not confined to any one specialty.

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Percutaneous Glycerol Trigeminal Gangliolysis for Tic Douloureux

TIC DOULOUREUX is a well-known syndrome of facial pain usually characterized by unilateral, paroxysmal, lancinating, electric shock-like pains in the distribution of one or more branches of the trigeminal nerve. The pain is unique in that it is frequently evoked by nonnoxious ipsilateral (trigger zone) stimulation, and neurologic examination shows little detectable trigeminal sensorimotor deficit. Episodes of pain last